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Co-Principal Investigator: Robert Kennedy, ERDC-EL

Title: Effect of organic contents on properties of fine sediment beds.

Topic Area: A2.1b **-** Sediment Transport Processes - Cohesive

Objective: Provide new knowledge of cohesive sediment erosion processes and release of associated nutrients plus improved algorithms for erosion/release rate as a function of bulk density, organic content, and other easily measured parameters.

Problem: Most of the fine sediments occurring in natural environments such as lakes, wetlands and estuaries contain organic material. The type and amount of organic contents are site-specific and may vary to a great extent. The bulk density and erosion rates of fine sediment beds are known to be significantly affected by the organic contents, however their influence has not been adequately quantified. Organic materials, nutrients and bacteria are attached predominantly and preferentially to fine sediments due to physical and electrochemical properties of clays. The erosion of fine sediment beds results in bringing millions of fine particles in suspension, which significantly changes the turbidity and chemistry of water column, thus affecting water quality adversely. Hence quantification of the process of release of nutrients in water column is essential.

Benefits: Correlation of erosion and nutrient release rate with organic content and other simple parameters will improve the accuracy of numerical models used for prediction of erosion of natural sediments occurring in connection with USACE projects. Improved knowledge of the processes and physically accurate models will increase public confidence in our project evaluations and enable the USACE to design and operate projects that enhance the aquatic environment. Addresses field needs 109, 70, 59, 38 and others.

This work produces new tools and methods for the USACE and nation. It is an integral part of the Regional Sediment Management Research Program, and thus contributes primarily to support of the USACE's navigation, flood/storm damage reduction, and environmental protection and quality missions. It supports all 8 Civil Works strategic goals and 7 of 9 Listening Session objectives identified by HQUSACE as R&D priorities. With companion work units, it employs active technology transfer and insertion.

Work Description: This work will test the following hypotheses: a) Decreasing organic content generally correlates with increasing bed density; in other words, higher organic content decreases bed density, b) Higher organic contents make the bed more resistant to erosion, and c) Rate of release of organic contents

from the bed into water column is a function of the type of organic and rate of erosion.

Laboratory experiments for measurement of nutrient release will be conducted jointly by the CHL and Environmental Laboratory. Field data already available and those proposed to be collected by ERDC at various project sites will be used for comparison with the laboratory results. Data collected by European institutions under the MAST program and those collected by other researchers, including U.S. universities, will be included in the analyses. The organic substances used will be water-soluble and will consist of both biogenic and industrial products. The work will consist of the following components.

1. Laboratory measurements of bulk density of clays and clay mixtures with varying amounts of water, types and amounts of organic matter.
2. Laboratory experiments on erosion of cohesive sediment beds of varying properties and composition in terms of clays, water and organic content.
3. Laboratory measurement of nitrogen and phosphorus released in water column during erosion.
4. Existing and new field data on release of nutrients will be analyzed and results will be compared with laboratory measurements. New field measurements will be coordinated with the work unit, “Framework for Integrated Solutions.”
5. A revised theoretical framework for fine sediment erosion and nutrient release will be formulated and tested against data.
6. A new general algorithm on sediment erosion including the effect of organic contents and release of nutrients will be written and delivered to work units under Topic B3.1: Improved multi-dimensional sediment processes models.

This work will be closely coordinated with a related work unit with the same participants in the SMART program so that experiments and findings will serve both programs. Advisors to the work will include: Carlos Ruiz, ERDC-EL, Allen Teeter, ERDC-CHL, and Joe Gailani, ERDC-CHL

Products and Schedule

The primary products of this work will improved knowledge of the role organic materials play in fine sediment bed characteristics and algorithms for erosion and release of nutrients for use in work units “Screening System for RSM,” and “Multi-Dimensional Sediment Processes Model.”

Product	Scheduled
1. TR: Effect of organic materials on the bulk density of fine sediment beds	Q4/02
2. TR: Erosion rates of clays and clay-mixtures containing organic materials.	Q3/03
3. TN: Erosion rates of fine sediment	Q4/03
4. JP: Erosion rates of fine sediment	Q4/03
5. Erosion rate algorithm for models	Q1/04

6. TR: Release of nitrogen and phosphorus in the water column resulting from erosion of fine sediment beds. (Summary Report) Q2/04
7. TN: Erosion of Fine Sediment and Release of Nutrients Q3/04
8. JP: Erosion of Fine Sediment and Release of Nutrients Q3/04